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Clock Synchronization in Wireless Sensor Network

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Abstract:

Wireless sensor networks have tremendous advantages in monitoring environment, civilian, military, health, home, education and scientific, it requires degree of synchronization to best results. The operation confirming that the processors spread over a wide area possess a standard time is synchronization of clock. At each sensor node their local clocks are synchronized to a common time. Its main applications are communication, security, industry. The focus on wireless sensor network is due to extensive application. There are many difficulties in building and designing sensor network and is a challenge of providing clock synchronization. It is very important that the application in wireless sensor network choose a correct clock synchronization method. This article illustrate the existing clock synchronization approaches in wireless sensor network and estimates the clock skew and clock offset in synchronization protocol.

Keyword: *Wireless sensor networks, clock synchronization, Frequency locked loop (FLL), Fundamental frequency estimation, time locked loop (TLL)*

I. INTRODUCTION

The wireless sensor networks are used to monitor the physical and environment changes like temperature, motion, pressure and sound. The wireless sensor networks are used in medical, industrial, military, and environment and scientific. The newer and robust approaches are used in clock synchronization in wireless sensor network. The synchronization scheme should have a higher order of accuracy, scalability and application. The sensor node is the basic component of wireless sensor network. The operation of collecting the data from its environment is the purpose of the sensors. Sensor nodes are set to have a common time. In wireless sensor network the sensors operate independently, there is a high chance for the clock is no more synchronized. Combining and explaining the information which is in different node is hard.

Over a large geographical area when sensor nodes are deployed may have certain changes in its operations due to climatic condition like humidity, temperature and also the variation in crystal oscillator. The accuracy in clock synchronization is variable and it is based on higher layer application requirement. The external reference in all nodes must synchronize in various clock synchronization protocols. The adjustment of time is examined and the hardware or virtual clock is modified and synchronized. Errors like inherent and accumulative is provided when the clock value is updated with the all other nodes. Some of the clock synchronization protocol modifies the clock recursively to get synchronized. The external or internal reference time is used only in few protocols.

II. CHALLENGES

WSN along with the sensor nodes are used for combining data, close observation of an offender. Each sensor nodes are timed by an inbuilt hardware clock

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and each clock is synchronized with the common time and also the clocks that are inside the node should have a proper synchronization.

Energy:

- The important challenge for a WSN is power capacity.
- Used in recognizing, broadcasting and data handling requires enlargement.
- The sensor nodes existence depends on battery.

Finite bandwidth:

- Energy consumed in handling the data is low when compared with power consumed for data transmission.
- The message exchanged among sensor is affected by bandwidth limitations and only when the message is exchanged bandwidth is possible.
- They operate in radio, infrared, optical range.

Security:

- The high security requirement with resource is the most important challenge.
- It provides security like node authentication and data confidentiality.
- The sensors which are deployed must succeed the node authentication test with the corresponding node.

Scalability:

- In applications the sensors are deployed and the number of nodes can be increased or decreased at any time.
- The synchronization scheme should work in a high compactness of nodes in the network.

Robustness:

- When the sensor network is waiting for long time.
- The unattended sensor and the network nodes is breakdown will not affect other nodes functionality.

Lifetime:

- The operation time for synchronizing the sensor nodes will last until its gets completed in the various synchronization algorithm.

Cost and Size:

- The very small and inexpensive device is wireless sensor nodes. Due to advanced technology the synchronization algorithm should be at low cost and size.

III. APPLICATIONS

Military:

- It is used to identify various attacks and presence of unsafe substance.
- When opponent aircrafts are spotted, precaution is taken for opponent attacks via warn is done.
- Used to check the companion forces, apparatus and projectiles.

Environment:

- Observing the conflagration, detecting swamp and in the detecting foreshock.
- The environment of an organism is observed.

Civil:

- Definitive area obtaining in a vehicle parking.
- Identifying the group of active person involved in the organization.
- Security in all the sector mostly in banks and shopping malls by using surveillance.
- Observing the highway traffic.

Health:

- Tracking and checking the availability of medic in health center.
- Establishing pre-determined condition, observing the health records.

Institution:

- Wireless networks are used in improvement, problem-solving environments like intelligent home and smart institutions.

Technological:

- Astronomical object analysis.
- Sub-marine analysis.
- Sub-atmospheric particles analysis.
- Analysis of physics with sub-atmospheric particles and interactions.
- Analysis of intergalactic matter.

IV. CLOCK PARAMETERS& RESULTS

Clock skew: It is the dissimilarity in clock frequency and absolute clock. Clock skew has two

Components. One component is a linear drift it is the frequency contrast between the transmitter and receiver.

Clock offset: It is the variance of the clock time and the absolute time.

Synchronization: The operation of adjusting clock readings such that they match.

Clock rate: It is the frequency at which the clock process. It depends on temperature, humidity, supply

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of voltage.it may cause the clock to differ even after synchronization.

Drift: It is the clock rate with regards to time.

Accuracy: The clock's maximum reference in regard to reference clock.

Precision: It is the maximum value of the offset at any two clocks.

V. LITERATURE SURVEY:

- The interchange of clock information between server and the client is followed in traditional clock synchronization. The communication delay is reduced; messaging protocol in connectionless network and based on the information of the server the client time is upgraded. NTP is a scalable, robustness, good performance and self-configuration in large network so it is used in internet. The various hosts in a pecking order synchronize the clients. Both NTP and GPS are used to get high accuracy in few microseconds.
- NTP based on various challenges in wireless sensor network alone is not suitable in wireless sensor network. To get a desired result with the great degree of accuracy in existing synchronization based on higher the requirement of resource. The precision of essential synchronization relies on the sector it is used. There is a relation between the demand and precision. The demand of the operation and available means of the processor

Depends on the above relation is the tenable accuracy in traditional clock synchronization.

Single-hop synchronization:

- The recipient-recipient synchronization technique is used in a single broadcast region. The message is passed directly from one node to another but exchange of message is not possible in a huge network.
- Single-hop synchronization provides a relative synchronization, common for most sensor network applications. The errors occurs at time needed to construct a message and waiting to retrieve from the communication channel , the timing-skew is recognized and timing-offset is also recognized in the single-hop synchronization.

Multi-hop synchronization:

- The multi-hop communication is used when the size of wireless sensor network is increased.The sensor in one area communicates with sensor in other area through in-between sensor that relate to both area. The several neighborhood nodes in sensor network are required by multi-hop synchronization.
- There is a great disagreement in time taken for communication exchange. To abstain from mislay in exactness, one or more nodes situated in distinct regions are synchronized by node in the convergence of the two regions.

Clock Period Time Variance:

- Test the scope of particular process of composite enginery in an industrial application using nodes, which are synchronized. The nodes are connected wirelessly and are synchronized to a base station. The important problem occurs in testing, restricting sensor nodes to a particular place and maximum efficiency of power occurs due to reference clock with its frequency or period estimation. In an industrial environment, synchronization events can be lost.
- The clock estimator is sparse and period gram estimator O (N log$N$) is the clock estimation. An equation for observing time is used to estimate the quality of clock period. The repetitive time valuator differs based on the provided precise value. The difference amount of time in clock is also estimated.
- The estimator with low MSE is used for an energy-saving synchronization. The estimator meets the ultralow power nodes. The estimator and MSE are used to support synchronized sensor nets development in harsh environment.

Secure and flexible Synchronization Scheme:

- The synchronized clock is accurate for much sensor network application. Clock synchronization schemes are proposed to label the resource limitations in a network. The techniques cannot survive malicious attacks. To detect malicious attacks and to prevent incorrect clock it will lead to contradiction of synchronization.
- In this example all the sensor nodes are synchronized to the external clock. The compromised nodes provides false synchronization and missing synchronization and this technique is used to tolerate the above mentioned attacks.
- There are two techniques used and the hierarchy level is used in a static sensor network.
- In dynamic sensor network the average diffusion algorithm synchronizes clock in absence of the assumption of structures. This model considers both the approach about various clock sources usage and tolerates the malicious source nodes.
- This demonstrates level based clock synchronization has less coverage and exactness than diffusion. The tinySeRSync is a secured and resilient time synchronization which is running in a small OS in a wireless sensor network. The μTESLA achieves global time synchronization and the protocol is assured against the attacks.

Time Locked Loop Synchronization Scheme:

- In this model the closed loop design is used and split into two. The matching of the clock frequency with the reference clock frequency called as syntonization. The constant clock offset is minimized called as synchronization. Syntonization approach is used in open loop design and synchronization is used in phase locked loop.
- The clock synchronization in Time locked loop is faster than closed loop design. This algorithm avoids the transient effect of PLL. It avoids feedback loop by synchronizing the frequency and the time.
- The proposed algorithm is TLL which is neither FLL nor PLL. The embedded hardware with finite capacity platform can be benefitted by time locked loop. The protocol like network and precision time are used to acquire level of solution in time synchronization.

Progressive Synchronization scheme:

- The data integration, implementation of TDMA and synchronous data acquisition are the important service of synchronization. The important problem is the power utilization where the batteries have finite capacity and it cannot be restored many time.
- The energy allocation enables the sensor nodes to manage the energy use. In this model a virtual common clock is introduced between the master and slaves. The approach proposed allows the node to rest for a long extends and its interchange synchronization packets that are rare. It also provides an excellent quality of common clock. The embedded devices with a middleware MAC use this dynamic continuous clock synchronization.

Repeated Time Synchronization:

- The existing protocol for time synchronization provides data consistency, coordination, accuracy, but absorbs great Energy and imperfectly synchronize those distant nodes. In this protocol the global clock is used to synchronize clocks provided.
- The global clock is accurate and energy efficient. It uses the Media Access Control sequence time. The reference node transmissions are fewer, and the delay in the message propagation and also the timestamp adjustment at each hop are blended technique.
- In order to run the RTSP method in cluster or flat network each node is considered as a cluster head. The election of a reference node, offset and drift are compensated. The simulation result shows the improvement in the accuracy and energy consumption by analyzing the source of error and efficiency.

VI. CONCLUSION

In this paper the various existing algorithm are studied and a summary has been presented. The emerging and increasing demand of wireless sensor network application there is a need for precise secure clock synchronization algorithm. The clock synchronization algorithm is important for error free measurements of clock. Clocks can be loosely or densely deployed in a framework. The timing-offset and timing-skew is taken away at the same time. This survey paper can make future researches to gain knowledge and to explore the existing clock synchronization approaches. This paper based on the study on various clock synchronization approaches, gives an easier choice to implement their application.

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